平成27年度　トピックス

分子・物質合成プラットフォームにおける利用成果
ドープ型$BiFeO_3$ナノ粒子の合成及び磁化特性に関する研究

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【目　的】

Multiferroic materials have attracted significant research interest due to their potential applications in data storage media, spintronics and ferroelectric random-access memories. The aim and objective of this investigation is the preparation of $Bi_{0.9}Gd_{0.1}Fe_{1-x}Ti_xO_3$ (x = 0.00-0.20) multiferroic system to observe the effect of temperature on their magnetic properties.

【成　果】

For magnetic characterization, the M-H hysteresis loops of $Bi_{0.9}Gd_{0.1}Fe_{1-x}Ti_xO_3$ (x = 0.00-0.20) nanoparticles were measured at different temperatures ranging from 20 K to 300 K with an applied magnetic field of up to ± 50 kOe. The coercive fields (Hc) and remanent magnetization (Mr) were extracted from the hysteresis loops and shown in Fig. 1. Both the Hc and Mr are higher for sample x = 0.10 than those for x = 0.00 and x = 0.20. The remarkable feature observed from Fig. 1 is that the coercivity of these ceramic samples increases with temperature. The temperature dependence magnetization measurements demonstrate clearly that both zero field cooled (ZFC) and field cooled (FC) curves of $Bi_{0.9}Gd_{0.1}Fe_{0.9}Ti_{0.1}O_3$ ceramic coincide with each other as shown in Fig. 2. The influence of cooling magnetic fields on exchange bias effect at temperatures 150 K and 250 K in $Bi_{0.9}Gd_{0.1}Fe_{0.9}Ti_{0.1}O_3$ multiferroic material is illustrated in Fig. 3. The exchange bias fields (H_{EB}) increased significantly upon the application of cooling magnetic fields. This magnetically tunable exchange bias obtained in these samples up to temperatures 250 K is promising for application, as most of the materials show exchange bias only far below room temperature.

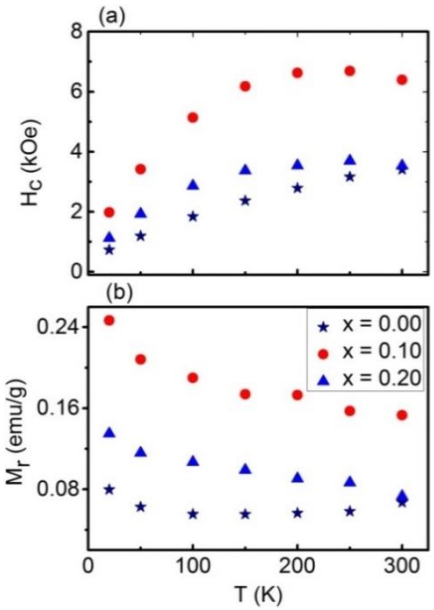

Fig 1: Variation of Hc (a) and Mr (b) as a function of temperatures.

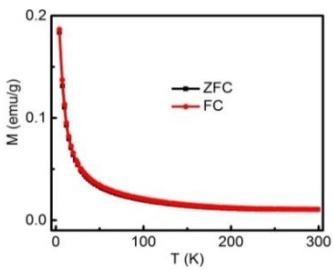

Fig. 2: Temperature dependent magnetization in ZFC and FC processes.

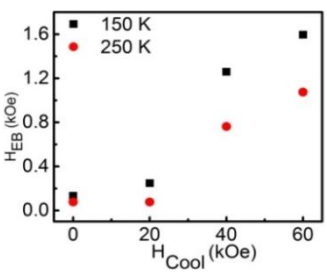

Fig. 3: The variation of exchange bias fields due to field cooling (H_{cool}).